DLP Cubes
vs.
Flat-screen Displays

eyevis GmbH
Hundsschleestr. 23
D-72766 Reutlingen
Germany

www.eyevis.de
info@eyevis.de
Tel.: +49 (0)7121/43303-0
Fax: +49 (0)7121/43303-22

Content

1 Displays for professional applications 3

1.1 Flat panel displays – LCD monitors 3

1.2 What is Image Retention, Image Sticking, Image Persistence, Memory Effect, Ghost Image? 4

1.3 Is image retention permanent? 5

1.4 Operating your display 9

1.5 Conclusion 12

2 Professional LCDs made in Germany 14

2.1 New LED backlight LCDs 15

2.2 24/7 LCDs 17

2.3 Measures to prevent premature damage to the display 18

3 Comparing different display technologies: DLP cubes and LCD monitors 21

3.1 Go Green – Go LED 24

3.2 LCD – DLP Comparison table 26

3.3 Comparison of total cost of ownership 28

1 Displays for professional applications

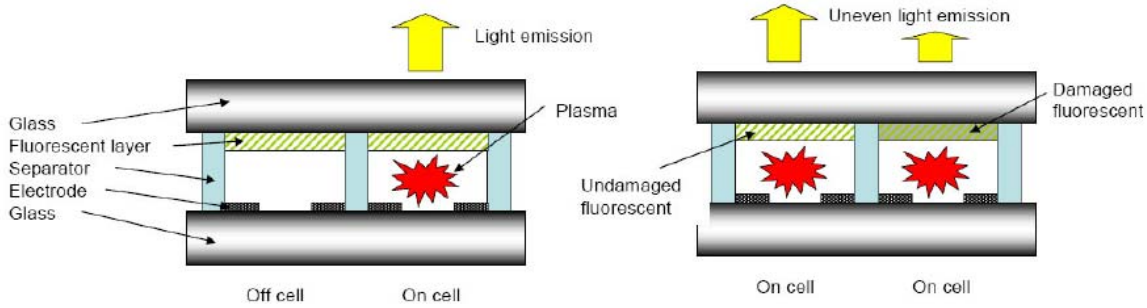
1.1 Flat panel displays – LCD monitors

The technologies used for large screen systems in professional applications are various, nowadays flat panel displays are becoming more and more popular and available in the market. Also the flat panel displays like LCD or Plasma displays are becoming more and more big so that they become more and more attractive for professional applications. These professional applications could be control rooms, digital signage, advertising, flight information displays, visitor guidance systems....

But displays for professional applications cannot be purchased off the shelf from any electronic store, because the Large screen systems for such applications should be ready for 24/7 operation, i.e. they have to match the requirements of continuous long-term operation and should comprise appropriate features.

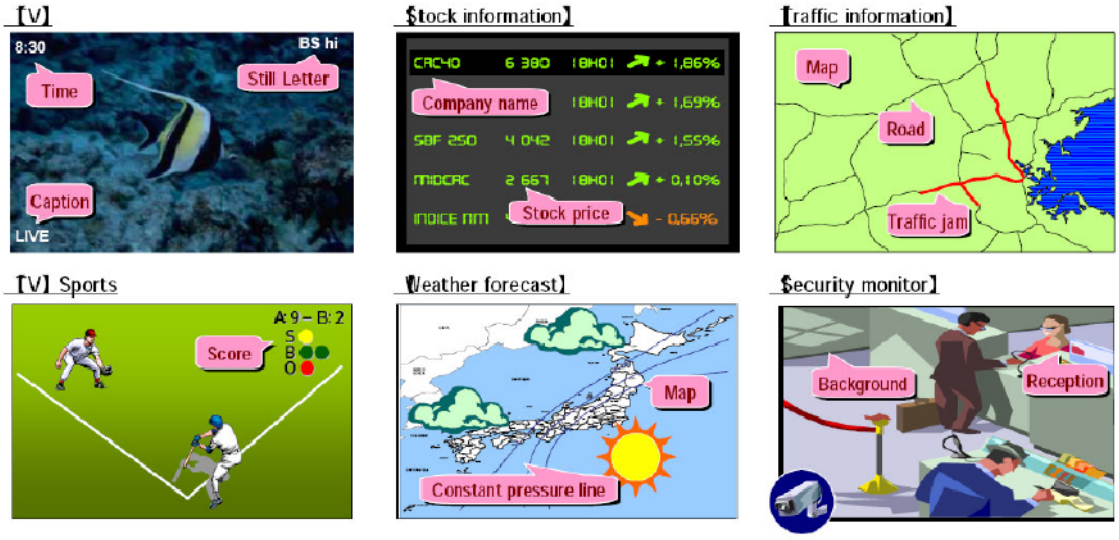
As we already know the old CRT monitors suffered from a burn-in effect when displaying static pictures. This resulted in an imprint of a permanent image in the display. It was caused from the continuous display of a particular image content in the display for an extended period of time. This causes a breakdown in the phosphors on the CRT and would result in the image being burned into the screen, the burn-in phenomenon. What about this phenomenon at flat panel displays? In fact Plasma displays also suffer from this effect and could not be used for continuous operation or for displaying static pictures. What about LCD monitors? As Plasma displays are not suitable for continuous operation, especially when displaying static pictures, we don't handle this technology in this paper.

Burn-in on PDP:



1.2 What is Image Retention, Image Sticking, Image Persistence, Memory Effect, Ghost Image?

Like burn-in on CRTs or Plasmas, image retention, image sticking, image persistence, memory effect, ghost images is caused by displaying continuously static images on the screens over an extended period of time (days, weeks, months). For one phenomenon different terms are used but have the same effect. Continuous displaying static graphics could be for example a windows desktop of a PC, label of a video window, network overviews etc. If you change the static content, with a new one, the previous one content could have been memorized in the background, these images are sticked in or occur like a ghost image. For example at airports this can be seen very often, the logo of the airline remain as a ghost image in the background while the content (in the foreground) is already changed. The image persistence or however you want to call it, can also be recognized by dark lines following the original edges of the previous content. This phenomenon occurs because the LCD crystals have a memory for their location to generate the colours of graphics. If a different colour will be displayed in that location the colour will be off from what it should be and instead have a memorized image from what was previously displayed. This problem affects the image content which does not change position, colours or shape, like e.g. displayed logos, taskbars, desktop icons or background images. To explain it more technically: When a fix image or repetitive sequence is shown over a sufficiently long period, the electrically charged ions that are always present in the liquid crystal material can collect at the LCDs panel electrodes. These ions cause a parasite electric field that affects the normal LCD behavior.



1.3 Is image retention permanent?

Contrary to the burn-in of CRTs or Plasmas, image sticking is in most cases not permanent. Therefore we can say it reversible, while burn-in is irreversible or permanent. The liquid crystals have a natural state and can shift depending on the amount of current used to generate the required colour. If these colours shift periodically the liquid crystals for that pixel will fluctuate enough, that the image will not be memorized into the crystals. In other words image retention can be reversed in most cases, but in some cases the time you will have to wait until it is removed is long at least as long as the image was shown on the display. This means you have to switch off the display completely (turning off the backlight only is not sufficient). During this switch off time the LCD panel will regenerate. After this regeneration period you can turn it on again and the memory effect on your display will be removed. But the exact regeneration time depends on the content you have shown and the duration of displaying this still content. For example, if you have displayed a static content for one year or longer, it is possible that the image sticking could not be reversed because the physical structure of the liquid crystals might have changed and the image retention will last forever. Image retention occurs slowly, but it will also disappear slowly. Memory effect, image persistence, image sticking, image retention affects every LCD monitor in the world, because it is the nature of this technology when showing still images. Of course there are professional manufacturers, who integrate optimizing features into their monitors for continuous operation like special screen savers, special cooling

systems, regeneration modes etc., but in order to be sure you have to take precautions it is like when you go in the sun, you will use sun cream otherwise you will get a sunburn. How fast you will get a sunburn depends on your complexion and if you are in direct sunlight or in the shadow etc. It is similar to the image retention. Which precautions can we take:

-display a scheduled content, if you have a matrix of displays in a video wall, move the images around the different displays from time to time. Means rotate your contents.

-use screen savers. At your desk, you use screen savers for your PC or laptop monitor, why don't you use screen savers for your large LCDs?

-If you operate the system 24 hours and you have static pictures, turn it off for at least 6 hours.

-switch off backgrounds or logos from time to time or rotate them within the display.

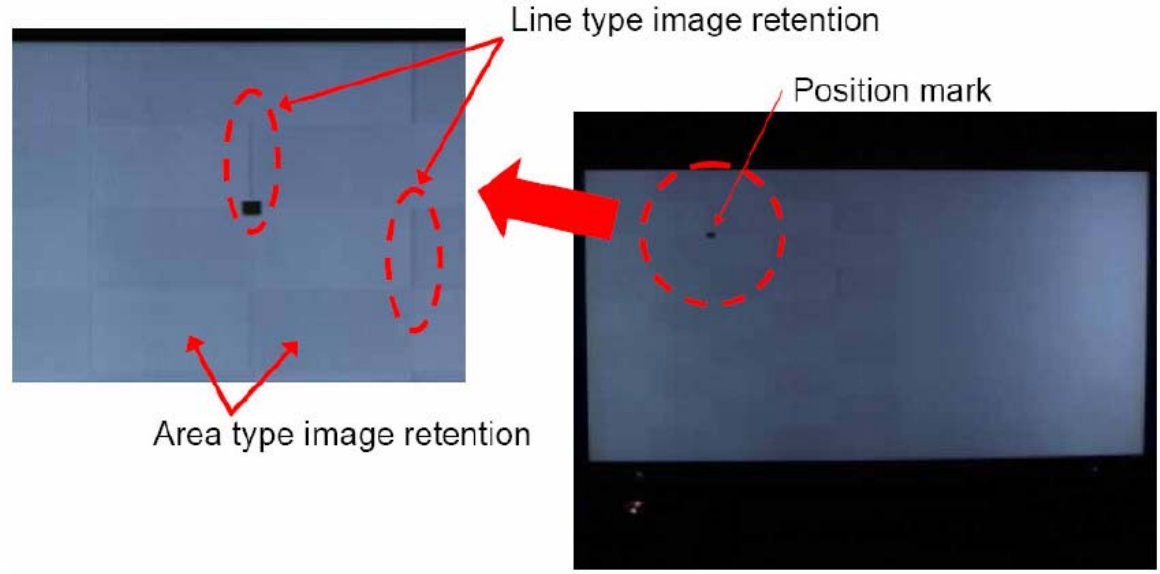
-turn off the system while you don't use it, e.g. lunch break, meetings,...

-evacuate heat from the displays as heat is one of the major reasons for the memory effect.

-use power saving modes.

-the more regeneration time you give to your display the better it will be protected.

Examples of Image Retention:



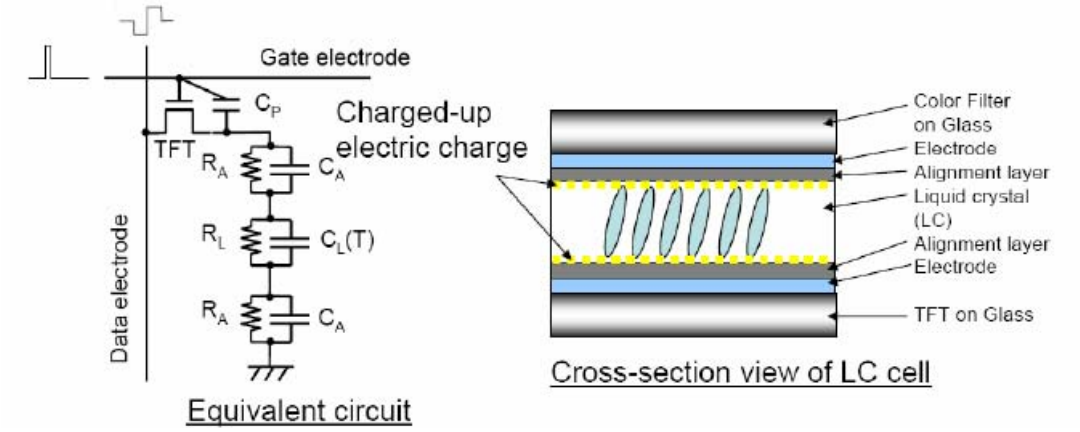
Area Type Image Retention

-LC Capacity (CL) changes with temperature and if LC temperature shifts, the voltage symmetry collapses with parasitic capacity (CP) between gate and cell electrode

-Interface of the alignment layer and the LC material is charged during long-term operation

-Area type image retention is the effect of this electrical charge

-Since there is a limit in the amount of electrical charges by the resistance (RA, RL), it can only be seen in dark gray level images and disappears over time when turned off.



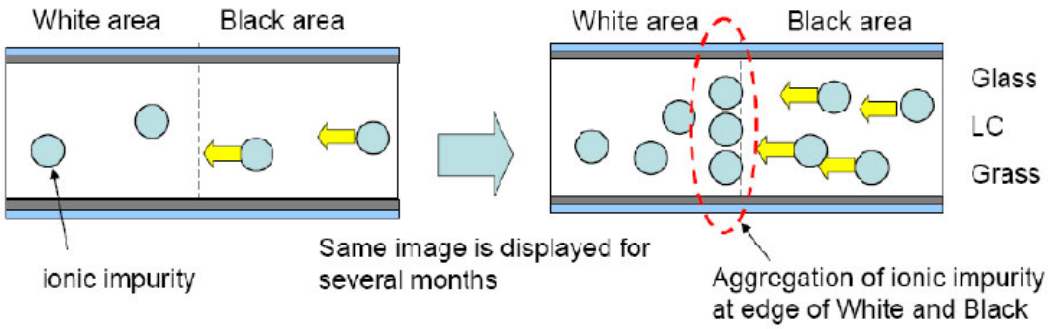
Line Type Image Retention

-Line type image retention is caused by aggregation of ionic impurity

-Aggregation of ionic impurity is caused by

1. The moving speed of ions changes with each gray level
2. The move direction is decided by internal electrical fields

-Line type image retention can result in actual damage to the LC display.



Are video images also critical for the image retention?

In principle it is ideal to run moving images on a LCD monitor, but e.g. in video surveillance applications the video image is moving very often but the windows have borders or fix labels during all the time. Also it is possible that the video images of a surveillance camera are also very static when nothing happens in the field of surveillance. That means, here you have to change the position of the different video windows from time to time and more than that also the borders have to be shifted regularly.

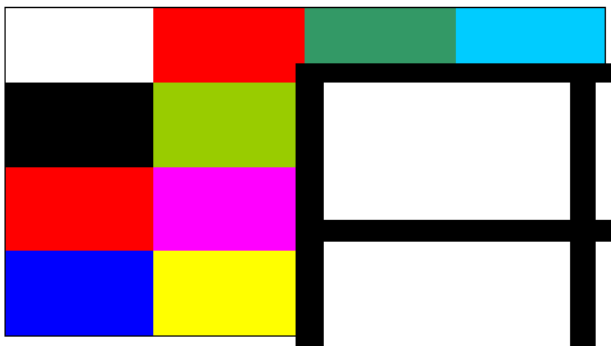
1.4 Operating your display

Don't use your LCDs at maximum brightness and contrast levels, as already mentioned above heat is the major factor for image persistence, means operating your system at full power, as well as the light and the heat from the backlights will have negative effects. You should not operate your system over 80% brightness and contrast (some manufacturers even don't recommend to go over 60%). It is also important to think about the colour usage, e.g. avoiding to display graphics with a high contrast (black graphics on a white background or white graphics on a black background). Use different colours and change them from time to time.

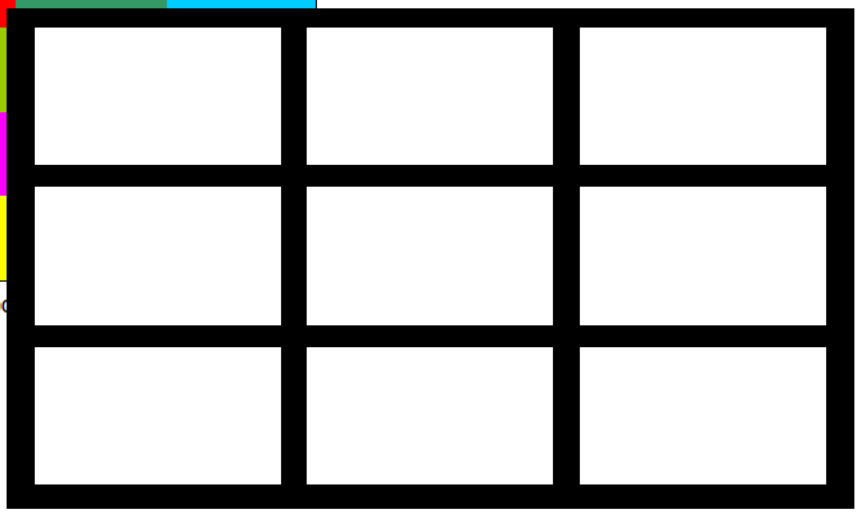
Like every machine or device also your LCD needs maintenance. E.g. your coffee machine at home needs to be decalcified periodically otherwise it will break. In other words service your system, make sure that the holes and fans are dust- and dirt-free at all time. Check your system frequently if there are signs of image retention, as if you start counter measurements too late it could be problematic to remove image retention. Such an image retention check could be done by showing a grey shade image on the display, for example if you show a 50% grey image and you can see the boundary lines of image retention it means you will have to change the layout of your screen quickly or to start immediately the regeneration processes.

Every LCD monitor suffers from image retention, one more as the other but keep in mind that there are only 4 raw LCD panel manufacturer for large size LCDs in the world and every display manufacturer has to buy from one of these 4. For every big screen diagonals not every of these 4 manufacturers offer size of bigger than 65". For professional applications never chose a fan-less LCD, as we have heard above heat is the major factor for image retention, by reducing the noise you increase the risk of image sticking.

Test patterns for image retention:

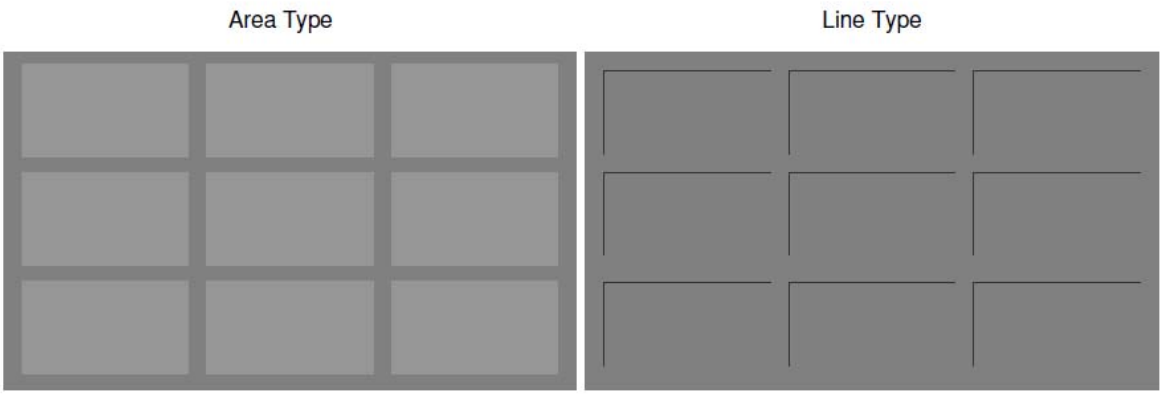


Color Wind



Black/White Window Pattern

Evaluation of Image Retention – Full Display Grey Scale Image



Examples of image retention

Heat caused image retention

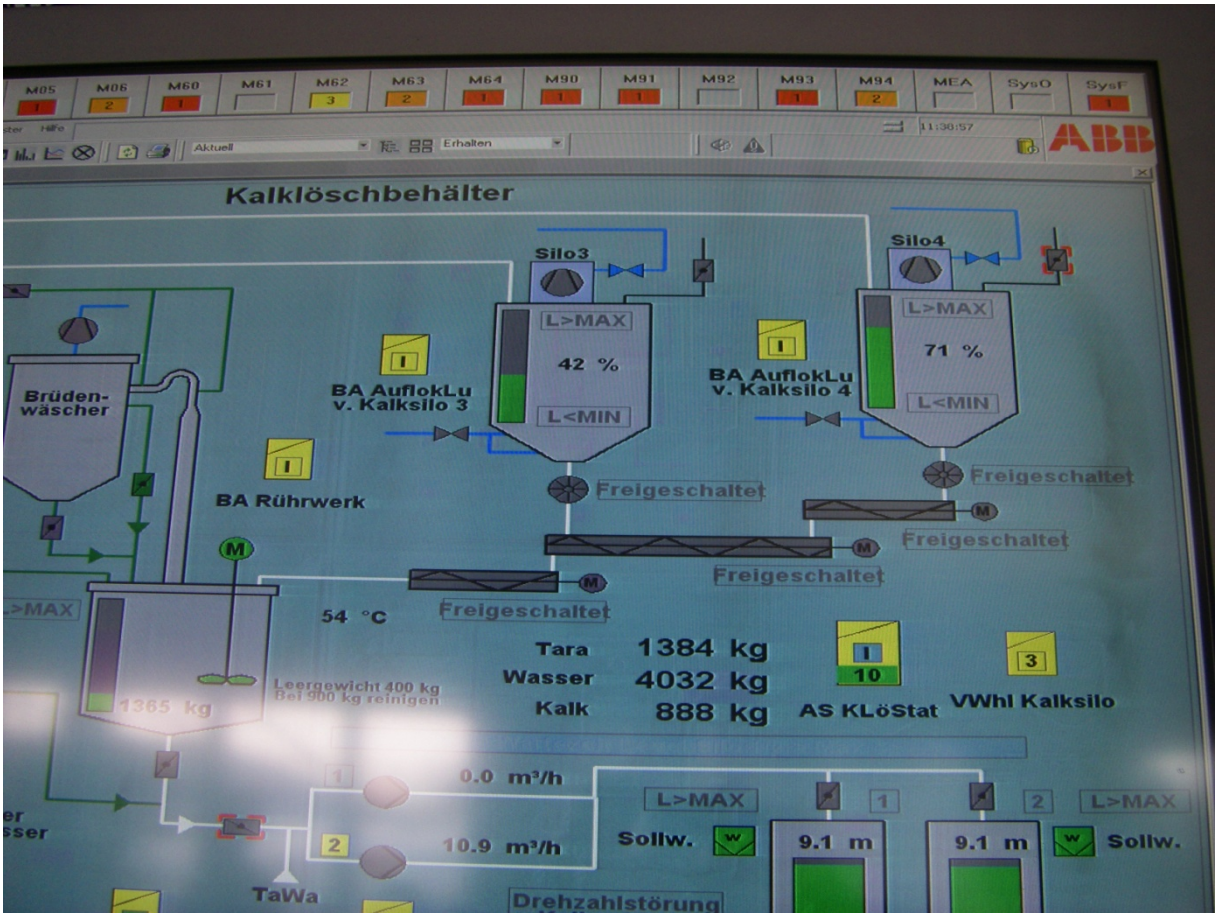


Image retention because of static image

1.5 Conclusion

Never use plasma displays for continuous operation or to display static images, because it will burn-in at this is irreversible.

If you display on LCDs relatively still or static pictures, it can cause image retention, image sticking, image persistence, ghost images or memory effects, these are in the most cases reversible.

In order to avoid memory effects you should not use fixed images and very frequently repeated clips. When this is not possible you have to take necessary precautions. This could be using screen-savers, switch the system off for certain hours, check regularly image retention occurrence, vary video clips as much as possible, use moving images, all this could help to reduce the risk of image persistence. In addition to this it is

important avoiding static bars at image boundaries. Also high contrast colours as black/white are not recommended to be positioned next to each other in a static content or frequently repeated image. High contrast when displaying video doesn't affect much, but repetition of the same image is not recommended. High contrast is accepted when there is a gradient from one colour to the other. Regarding contents there are several rules which have to be respected, like avoiding to use a combination of characters and background colours with a large difference in luminance. Use colours with little difference in luminance, alternate the character colours in complementary manner (from green to red to blue), alternate background colours every 30 minutes to a new position. As we have heard heat is the top reason for image persistence, it means avoid exposing your displays to high ambient temperatures, try to evacuate the heat created by the displays. At every time ventilation holes should always be dust and dirt free. Also you should respect aspect ratios, as for example if the signal is 4:3 and it should be shown on a 16:9 display keep in mind that there will be black areas and the borders of these black areas could persist when image is changed.

2 Professional LCDs made in Germany

eyevis is offering LCD monitors for video wall applications, lilke the EYE-LCD4000/4600/5200W or M series as well as the EYE-LCD4600-SN.

Advantages eyevis narrow and super narrow bezel LCDs compared to standard products on the market:

· Special scaler for excellent presentation of images with resolutions, which deviates from a native resolution of 1.920 x 1.080 pixels. The converted images are represented in a very good representation.

· Experience and references in continuous operations with the display electronics since 6 years in 24/7 operation.

· Experience and references in continuous operations with the display diagonals of 40"-52" since 2 years in 24/7 operation.

· LCD-Display in diagonals of 40" - 64" with identical technology/electronics available.

· Modular configuration of the displays. At failures the according assemblies can be changed by the user, therefore a high availability is achieved.

· LCD-Control-Software, which prevents from memory effects, with the possibility to schedule this function in time intervals. Scheduler Function, Screen Saver (Running Line)

· Heat is the major reason for the memory effect, therefore the M-version has integrated cooling channels to evacuate the heat from the displays to prevent from memory effects. Also the displays are not designed fan-less for this reason.

· Panel regeneration mode and inverting of images for prevention of memory effects.

· The LCD-Displays are available in the long-term with the same design.

· Manufacturing and R&D of the devices in Germany.

· Numerous mounting accessories are available, therefore multifunctionally deployable. Wall-mounted, in display rack as stand alone, base stands for integration in interior design, special constructions.

· For monitor wall applications, a central IR sensor is used that the matrix of displays can be controlled by one single remote control.

· No disturbing front control LED's for the displays.

· Internal splitcontroller for a matrix of 10 x 10 displays with 2 x DVI, 2 x RGB, 2x video, 1x RS-232 inputs and 1 x RS-232 output.

· Excellent viewing angle without overhang of display housing.

· Data based control software over RS-232, IR remote or on panel control.

· Stable metal housing.

· Stackable for monitor wall applications, with an quick and easy mounting concept.

2.1 New LED backlight LCDs

One of the latest products in the eyevis LCD family is the LED-backlit LCD. Unlike conventional LCDs in previous years, the LED LCD makes use of different technology in its backlight structure. Its backlight structure is composed of LED light bulbs, which are more efficient than CCFL (Cold Cathode Florescent Lamps) bulbs in terms of delivering a realistic graphic display. It has many advantages compared to the traditionally used CCFL bulbs and increases the quality of the viewing experience.

The LED-backlit LCDs have a better color gamut, giving way to a fine color display. This feature of LED LCDs results in a realistic graphic output which is easy to interpret visually. For this reason, the LED backlight should be preferred in order to enjoy quality display output. The LED backlight also has dynamic colour contrast and works great in fast-moving transitions, so detailed video streaming can be expected.

This advantage of LED backlighting results in a provision of a wider colour gamut compared to CCFL backlit LCD s. LED's cover a broader range of red and greens (up to 114% of the NTSC standards):, the full area of the RGB natural colour space. Being able to display a more extensive range of colours means the attribute of colors is more natural or lifelike as they are closer to the human eye's colour perception range. More significantly is where that increased range is - in the areas of greens and reds, which really should make an **impact on how accurately and vividly images are rendered on screen.** This is of key importance for a colour-critical workflow situation. The LEDs also emit a more uniform light and degrade less quickly than CCFL backlight, which results in a more stable brightness over the lifetime.

LEDs have other advantages too. There's virtually no warm up time required, so you don't have to wait for your monitor to stabilise to get correct colours. Next, they are more eco- friendly, in that they don't contain mercury. Thirdly, they're more robust as they're much less susceptible to sudden failure or burnout. They can fade over time, but even with regular use you're looking at many years of benefiting from your LED-backlit screen.

The LCD LED backlight has small power consumption. This is important for applications where the electrical power consumption has to be monitored, and you can save a lot of money from this LCD's low voltage requirement. Although it has smaller power requirement, it is still efficient in delivering quality display outputs. An LED-backlit display can consume up to 45% less power than CCFL bulbs.

Also, in terms of design, the LED backlight LCDs offer various advantages: they have a slim design, with only 46 mm depth and a bezel of only 25 mm to meet space limitations for integration and installation. This design is much deeper and offers a slimmer bezel than traditional CCFL-backlit LCDs.

2.2 24/7 LCDs

There are also LCDs available for 24/7 operation even with static image content. But there are requirements and instructions that have to be taken into account.

Required measures

Generally, TFT panels are subject to different ageing processes. This requires special countermeasures to minimize the early appearance of effects disturbing the quality of the displayed images („uneven picture“, „image sticking“, „boundary line“).Besides certain software functions, these are simple instructions for use concerning duration of operation and display settings.

Following screensaver functions have to be activated:

Pixel Shifting (minimum. 4 pixels)

Dynamic Pixel Refresh (at least level 1)

Soft Picture Mode (at least level 1)

Maximum Backlight Brightness according to the ambient temperature

Additional instructions for use

The backlight brightness in continuous operation must not exceed following values:

- up to 50% in an ambient temperature of 40°C

- up to 75% in an ambient temperature of 35°C

- for a brightness level of 100% the ambient temperature must not exceed 30°C

The maximum ambient temperature must not exceed +40°C. An internal temperature sensor initiates the switch off of the device when the ambient temperature exceeds permitted values. A status message of the temperature bit reports the value “out of range“.

Recommendations for enhanced lifetime of TFTs in continuous operation:

We strongly recommend to switch the device to Power Mode 2 („power save“) for at least three hours within a 24 hour period (via RS232 control). This is a special screen

regenerating mode which switches the panel to white, while the backlight is switched off.

2.3 Measures to prevent premature damage to the display

In general, TFT displays are subject to various aging processes (Image Sticking, Boundary Line).

Therefore, it is necessary to take appropriate counter measures in order to optimize the display quality of devices in continuous operation. The activation of the hereinafter described actions is highly recommended and is a prerequisite for compliance with the warranty conditions.

Pixel shifting

Continuous shifting of the entire image in different directions prevents image sticking. At normal viewing distance, this is almost not visible.

It is recommended to keep the factory-set value of 4 pixels. In this case the image is shifted by 4 pixels to the top, bottom, left and right.

The shifting of the image is performed in a 1 minute interval in steps of 1 pixel.

See the user manual for more information on the adjustment.

Dynamic pixel refreshing

With dynamic pixel refreshing thanks to the intrusion of an artificial noise pattern image sticking is reduced.

This is done by a selective switching on/off (pulsation) of the TFT cells

The procedure is virtually invisible to the viewer a and increases display lifetime considerably when static image content is displayed

We recommend to keep the factory-set value (Level 1)

See the user manual for more information on the adjustment

Soft Picture Mode

This technology is similar to a blur or softener effect

This intelligent scaling mechanism smoothes out extreme contrast transitions in the displayed image. The procedure is virtually invisible to the viewer.

It effectively prevents Boundary Line Image-Sticking which is likely to occur on sharp detailed transitions (e.g. black to white)

We recommend to keep the factory-set value (Level 1)

See the user manual for more information on the adjustment

Adjustment of the Backlight Brightness

The backlight of the screen is controlled with the „Backlight Value“ or „Image Adjustment“ in the OSD

The backlight brightness in continuous operation should not exceed:

- up to 50% in an ambient temperature of 40°C
- up to 75% in an ambient temperature of 35°C
- for a brightness level of 100% the ambient temperature should not exceed 30°C

The factory setting for the backlight brightness is 50%. We recommend to keep this setting; this setting allows approx. 270cd/m² for a panel with a maximum brightness of 500cd/m².

The lower the setting for the backlight, the more this extends the lifetime of the device and the more image sticking is avoided.

Additional Measures

We recommend to switch off the device or to switch it to stand-by mode for at least 4 hours per day (using the RS232 interface)

We recommend to display changing contents (e.g. by using moving images or video)

The display of image content with extreme contrast transitions should be avoided (e.g. black/white - white/black transitions)

Care for sufficient ventilation of the device (please see the user manual for acceptable operating conditions)

Keep the device free from dust. Especially the ventilation holes have to be checked every three months and cleaned if necessary.

3 Comparing different display technologies: DLP cubes and LCD monitors

Which technology to choose?

We have seen the advantages of the flat panel displays, which are availability, price and less space requirements. But we have also seen that there are some disadvantages especially when displaying relatively still images. If you respect the different precautions for the LCD monitors, they could be an alternative for continuous operation like in control rooms.

The technologies most often used in control rooms of today and tomorrow, are rear-projection cubes, based on DLP™ technology, and LC displays. Rear-projection cubes are available with various screen sizes and resolution standards. Numerous of these cubes can be combined to almost “seamless” large screen walls. The main advantage of these systems is their invulnerability for burn-in effects with static image content. Further, these cubes offer several optimising features, such as automatic double-lamp systems, or automatic adjustment of colour and brightness. In addition to that, the components used for these devices are designed for long-term operation. Another display technology, primarily used in domestic environments, are plasma displays. These are excellent for the display of video data for consumers, but not for control room applications. Plasma displays are very likely to suffer from burn-in effects already after short time when static images are displayed. This can even happen with video images from cameras, since they usually show the same area and much of the content remains unchanged. Burn-ins can also happen with On-Screen elements of the camera signal, like the camera number or channel ID. “Burn-in” describes an irreversible affection of the phosphor layer, and therefore a sustainable defect of the device. Lower costs when the system is purchased may now turn into the opposite.

In the recent past, we observe an increasing number of large screen systems using a matrix of LC displays. Here, it is important to note that professional devices are used providing optimised features for long-term operation. Although LC displays are not so much endangered by burn-in effects with static images as plasma displays are, they may suffer from similar effects, like memory effects and ghost images. This memory

effect does not turn up immediately; it is reversible and in general disappears completely when the display is switched off for about 24 hours. There are several methods available to avoid this risk. One possibility is to switch the display off for 4-6 hours within 24 hours. Another solution could be to switch the images from on display to another from time to time (e.g. different wall layouts for night and day operation). With a scheduler tool, like the one integrated in eyevis' eyecon wall management software, this can also be done automatically. Of course, it is also possible to use a kind of screen saver. The eyevis EYE-LCD series provides a so-called running-line screen saver option. This running line is only one pixel wide and can be adjusted regarding time and speed activity. This kind of screen saver does not affect the readability of the information displayed. For control room applications one should keep hands off cheap, fan-less LC displays, since heat is one of the main reasons for the appearance of memory effects. The displays from eyevis' EYE-LCD series provide several fans which use special ventilation ducts to dissipate the heat produced by the displays of a monitor wall.

So, if we make a direct comparison of the different technologies, we can exclude the use of plasma displays from control room applications due to their sensibility for burn-in effects, their minor resolution and the wide gaps between the displays when used in a combined video wall. Common projectors for office applications should also not be taken into account. What is left for professional video wall applications are DLP™ cubes of professional LC displays. Besides the display solution, sophisticated large screen systems generally comprise a so-called split controller including appropriate control management software. To avoid problems of interoperability, the preferable solution should be to receive all of these components from one provider. One of the only manufacturers who are able to provide complete one-stop solution is eyevis. With its EC DLP™ rear-projection cube series, its EYE-LCD series, the Netpix graphics controllers and the eyecon wall management software, eyevis is able to provide complete systems for any kind of control room application.

LCD monitors are already available with a relatively thin bezel which is especially important for modular video wall applications. Eyevis offers these systems in 40", 46" in WXGA resolution and from May onwards in native HD resolution and 52" in native HD resolution, these are the EYE-LCD4000M/W, EYE-LCD4600m/W or EYE-LCD5200M/W. They are available in wall mounting version (EYE-LCD4000/4600/5200W) or as a modular stackable version (EYE_LCD4000M, EYE-

LCD4600M, EYE-LCD5200M). But with approximately 14mm per LC display, the resulting gap is still much wider than with cubes which provide a gap of only about 0.3mm per cube. As technology is continuously developing further, the gap for LC displays has become smaller, for example with the eyevis EYE-LCD4600-SN with a gap of 7,3 mm display to display, available in 1.366x768 pixels. The aspect ratio of LC displays is always 16:9, whereas many software applications in control rooms produce images in 4:3 or 5:4 also very rarely 16:9 (16:10). This results in distorted images when the displayed in full-screen mode. Or the display shows black zones bottom and top, or on both sides, if the image is displayed in native aspect ratio. DLP cubes are available with all common aspect ratios, 16:9 (16:10), 4:3 and 5:4. Further differences can be observed when we look at the available display resolutions for both technologies. LC displays usually only offer two different resolutions; these are 1366x768 and 1920x1080 pixels. Here, cubes can once more show their higher flexibility, since they are available with 1024x768, 128x1024, 1400x1050 and 1920x1080 pixels. Cubes with resolutions up to 1920x1200 pixels are already under development. A disadvantage of the DLP cubes is the high-performance lamp used for illumination. These lamps have an MTBF of approx. 10,000 hours. To guarantee higher reliability of the systems, they can be equipped with automatic double-lamp systems, i.e. the system automatically switches within seconds to a second spare lamp if the operating lamp breaks. Cubes using alternative light sources for illumination (LED) provide a higher MTBF of > 55,000 hours for the LED lamps and >100,000 hours for the power supply are already offered by the German manufacturer eyevis. If you compare LED light DLP cubes to normal UHP lamp DLP cubes, you have much lower operating costs, as well as a more eco-friendly solution as in the UHP lamps mercury is used.

3.1 Go Green – Go LED

eyevis is always ahead with their new developments, so also with their new DLP rear-projection cubes with LED light source. These systems are available in 60” and 67” full HD resolution (EC-60-LHD, EC-67-LHD), 50”, 70” and 80” SXGA+ resolution (EC-50-LSXT+, EC-70-LSXT+, EC-80-LSXT+) and 70” WUXGA (EC-70-LWXT).

Advantages of these systems:

-High lifetime:

MTBF of >60.000 h for the LEDs , no lamps required, no colour wheels required

MTBF>150.000 h for the power supply

-High-end Optical Performance:

High contrast, High Colour Gamut RGB Illumination System, excellent colour representation and contrast, improved black values

lower costs for operation and maintenance

more eco-friendly since no mercury is used

better colour adjustment

Comparison of standard UHP lamp (colour wheel) DLP cubes with LED light DLP cubes over 10 years (1 cube):

Component	UHP lamp systems	LED light systems
Lamps MTBF Required spares	8.000-10.000 h (12 lamps)	>60.000 h (3 LEDs)
Colour wheels MTBF Required spares	25.000 – 30.000 h (approx. 4 colour wheels)	- -
Power supplies MTBF Required spares	40.000 - 50.000 h (2x low voltage PS, 2x high voltage PS)	>150.000 h -
Labour costs	Approx. 15 interventions	Approx. 4 interventions
Total cost saving		> 50%

LC displays have no lamps for illumination. Here, the light comes from the so-called panel backlight, which can be either LED-based or a kind of tubular fluorescent lamp. In general, these panel backlights are indicated with an MTBF of about 50,000 hours. The core of a DLP cube is the DMD (Digital Micromirror Device) chip with an MTBF of 100,000 hours.

3.2 LCD – DLP Comparison table

Feature	**LCD Monitors**	**Valuation**	**DLP™ Cubes**	**Valuation**
Image retention of static pictures	Yes	-	No	+
MTBF Main parts	Panel 50.000 h	-	DMD 150.000 h Lamps UHP 10.000 h Lamps LED >65.000 h	+
Aspect Ratio	16:9	-	4:3, 5:4, 16:9, 16:10	+
Resolutions	1366x768, 1920x1080	-	1024x768, 1280x1024, 1400x1050, 1600x1200, 1920x1080, 1920x1200	+
Gap between adjacent modules	Narrow bezel 14 mm (28 mm) Super narrow bezel (7,3 mm)	-	0,3 mm (0,68 mm)	+
Image size per display in inch	40, 46, 52” with narrow bezel 46”,55”, 60” with super narrow bezel 65, 70, 82 (only with broad bezel)	-	50, 56, 65, 67, 70, 80, 84, 100	+
Installation depth	25 – 40 cm	+	1,00 – 1,60 m (with room for technical	-

			installation behind the cube wall)	
Control	External or internal Controller	+	External or internal Controller	+
Installation	Wall mount, display rack or integrated	+	Integrated or free standing	-
Autom. colour and brightness adjustment	----	-	available	+
Service Interval	1-2 per year	+	1-2 per year	+
Availability of spare units	? (sizes and resolutions change quite quickly)	-	10 years	+
Operation in 24/7	Max. 0,5-1 year	-	10 years	+
Total		**- = 9**		**- = 2**
		+ = 4		**+ = 11**

A modular matrix of screens made up of LCD monitors or DLP cubes is generally controlled by a so-called split controller which provides special graphic boards for incoming and outgoing signal sources (RGB, DVI, LAN, analog Video or IP Video). With these graphics controller units it is possible to display all connected signals and sources on the large screen wall. These signals can be PCs connected via RGB or DVi inputs, applications running directly on the controller, network sources and video signals, for example. The split controller should support real-time display of the sources. Further, streaming video or video over IP should be decoded by hardware decoding cards inside the controller. With a comfortable software solution like eyevis' eyecon software, it is possible to control and administer the complete system and all connected signal sources.

As mentioned before, eyevis is one of only few manufacturers which can provide complete one-stop solutions for any kind of professional large screen system. eyevis is also famous for providing customised solutions and specially designed products for sophisticated projects.

3.3 Comparison of total cost of ownership

This comparison takes an operation of 10 years into account, the compared large screen technologies are LCD, DLP-Cube with UHP lamp and DLP-Cube with LED light source. The eyevis products for this comparison are:

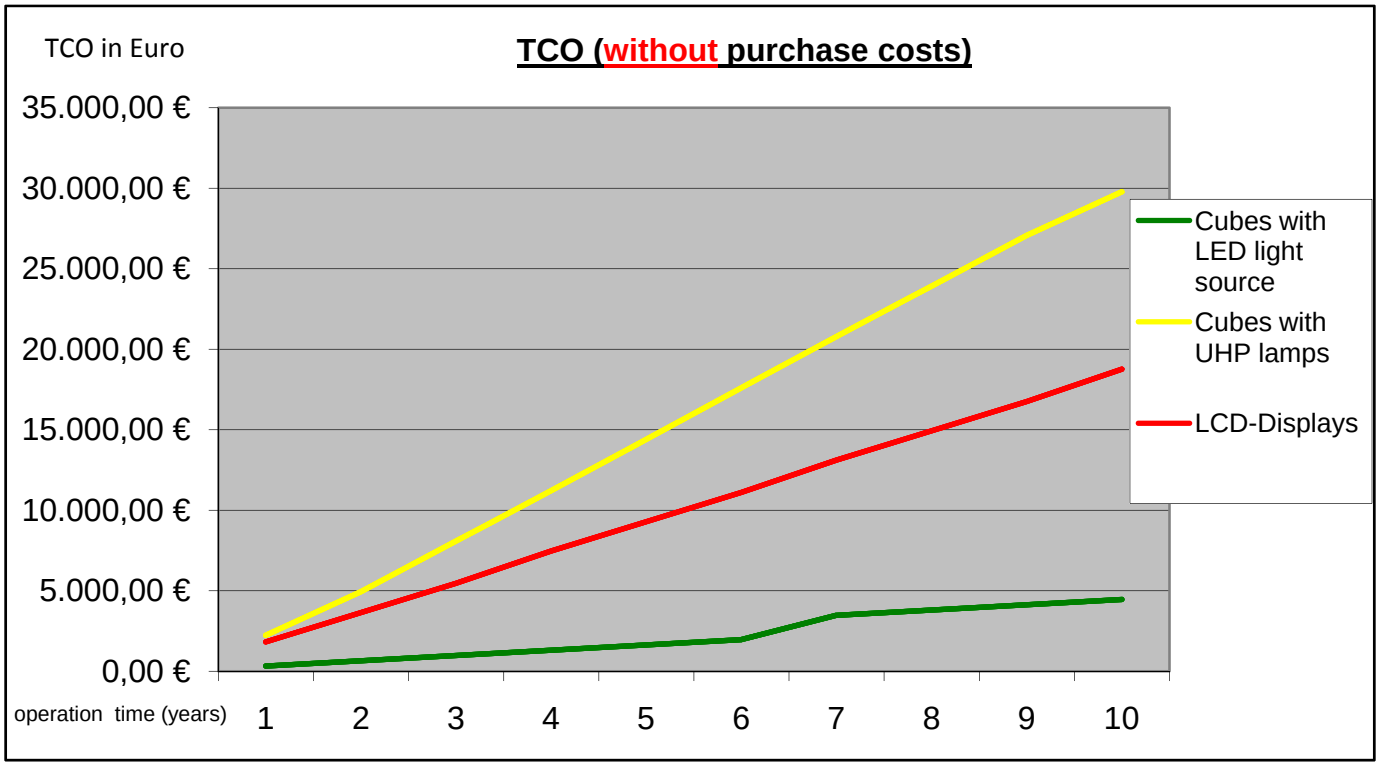
- EYE-LCD-6500-HD
- EC-67-HD
- EC-67-LHD

These products were chosen because they have almost the same screen size and HD resolution.

The values that were taken into account for the comparison are:

- LED light source
- UHP lamp
- colour wheel
- high voltage power supply
- low voltage power supply
- LCD-Display
- Energy
- service technician
- purchase costs DLP cubes with LED light source
- purchase costs DLP cubes with UHP lamps
- purchase costs LCD-Displays

Based on these values the following graph shows the differences in TCO.



Result:

With DLP cubes with LED light source you can save MTBF in an operation of 10 years compared to DLP cubes with UHP lamps:

25.313,70€ or 85,02%

With DLP cubes with LED light source you can save MTBF in an operation of 10 years compared to LCD-Displays:

14.305,50€ or 76,24%